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April 14, 1947

INTERIM REPORT ON PRODUCTION TEST NO. 105-97-3

DETERMINATION OF REACTIVITY COEFFICIENTS AND ROD CALIBRATIONS OF F PILE

Introduction

A test was performed on April 2, 1947 to determine the reactivity power coefficients and the graphite relaxation period of the F Pile in accordance with the procedure described by this Production Test.

SUMMARY

The power level of the F Pile was lowered 28 MW for a period of five hours on April 2, 1947. Analysis of data obtained during and after this period of operation at a reduced level has given the following results.

Coefficient	Drop	Rise	Average
Graphite coefficient, ρ_0	0.66 1h/MW	0.67 1h/MW	0.66 1h/MW
Metal coefficient, ρ_m	-0.20	-0.21	-0.20
Overall coefficient, ρ_0	0.46	0.45	0.46
Relaxation period	80 minutes	86 minutes	83 minutes

A plot of the observed reactivity transients and those calculated for xenon and long term gains is included as Figure 1 of this memorandum.

The values obtained for the overall coefficient and the graphite relaxation period are considerably higher than those obtained on the last previous test (13-19-46). The differences cannot be explained satisfactorily.

Details

At 10:00 AM on April 2, 1947 the power level of the F Pile, which had been at 200 MW for over 72 hours, was dropped to 172 MW and held steady for a period of five hours. At 3:00 PM the power level was raised to 201 MW and held steady for five hours after which time it was again reduced to 200 MW. Each of these level changes was performed in less than two minutes.

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The A Rod Calibration used to interpret critical rod positions observed during the test is based on a combination of two types of calculations. The region from all in to 120 inches out has been calibrated by comparing rod motion with xenon calculations following several different startups. The region from 120 inches to all out is based on a study of the neutron distribution along the path of the rod as indicated by exit water temperatures of tubes along the path of the rod.

The xenon transients introduced by the power changes comprising the test were calculated by means of the standard xenon equations for 350 inches of flattening and 32 metal pieces per tube.

A linear correction of 0.7 inhour per day was allowed for the long term gains experienced during equilibrium operation at 200 MW.

A comparison of the observed reactivity changes with those calculated, neglecting power coefficients, is given in Figure 1. The values of the power coefficients and the graphite relaxation period were determined as described in Document #7-4559, "Manual of Standard Practices, 100-300 Technical", Section II, Item 7.

Continuation of the plot of Figure 1 beyond the time that the power level was returned to the original value of 200 MW shows that the observed and calculated reactivity curves become coincident within 0.1 inhour. This fact gives added weight to the correctness of the A Rod calibration curve used in analyzing the test.

The values obtained for the overall coefficient and the graphite period are considerably different from the corresponding values of 0.40 ih/MW and 67 minutes respectively obtained from the test of December 18, 1946. The higher value for the overall coefficient is now inconsistent with the trend indicated by results obtained at various times since the startup of the P Pile. It does discredit any idea that this coefficient may have become essentially constant at about 0.4 ih/MW as may have been suggested by recent tests. The graphite period of 83 minutes is difficult to explain. It is an indication that a large drop in the thermal conductivity of the graphite has taken place since the last test whereas central graphite temperatures have not changed appreciably during this interval.

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